AF/2877

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Bruce et al.	Examiner:	Turner, S.
Serial No.:	09/386,112	Group Art Unit:	2877
Filed:	August 30, 1999	Docket No.:	AMDA.261PA
Title:	DUAL-DIFFERENTIAL INTERFEROMETRY FOR SILICON DEVICE DAMAGE DETECTION		

13/Appeal Brief (NE)
G. Sturg
6-29-01

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this communication is being deposited, in triplicate, in the United States Postal Service, as first class mail, in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on June 19 2001.

By: Kelly Waltigney
Kelly Waltigney

APPEAL BRIEF

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This is an Appeal Brief submitted pursuant to 37 CFR section 1.192 for the above-referenced patent application, in which claims 1-16 stand rejected.

I. Real Party in Interest

The real party in interest is Advanced Micro Devices, Inc., having a place of business at 5204 E. Ben White Blvd, Austin, Texas. The above referenced patent application is assigned to Advanced Micro Devices, Inc.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of Claims

Claims 1-16 stand rejected under 35 U.S.C.§112, first paragraph; and claims 1-16 stand rejected under 35 U.S.C.§103(a) as being unpatentable over *Marx et al.* (U.S. Patent No. 5,880,838).

IV. Status of Amendments

An Office Action Response including an amendment was filed on December 22, 2000 in response to a first Office Action on the merits mailed on September 22, 2000. A second (final) Office Action on the merits was mailed on January 30, 2001. A response to the second (final) Office Action was filed on March 30, 2001. An Advisory Action dated April 13, 2001 indicated that claims 1-16 stand rejected for purposes of Appeal, and a Notice of Appeal was filed on April 20, 2001.

The claims in the current amended state are attached hereto as an appendix.

V. Summary of Invention

The present invention is directed to analyzing a semiconductor die and detecting one or more defects at a surface within the die. In one particular example embodiment of the present invention, a semiconductor device that includes a semiconductor die (202) is analyzed to detect a defect (232) at a surface (231) in the die. The surface and defect may include, for example, a defect in one material type (such as within a well region) where the reflecting surface is a transition from one concentration of doped silicon to another concentration of doped silicon (such as from a p+ epitaxial silicon to an active or well region). In addition, the defect may include one or more contaminants such as potassium deposits, fractures in the silicon, various crystal defects, particulates and dopants found at a surface within the die. Light is directed through a first beam splitter (220) that is adapted to direct a first beam of light into the back side of the semiconductor die (202) that reflects a second beam of light back. The second beam is redirected to a second beam splitter (222) that generates third and fourth beams of light d_1 and d_2. The third and fourth beams are directed at detectors (228 and 230) and analyzed in one or more of a variety of manners to detect a defect within the die. For example, the time differential of the arrival of the third and fourth beams can be detected and then compared to a reference differential previously generated using a non-defective die.

VI. Issues for Review

ISSUE 1: Is the Section 103(a) rejection of claims 1-16 over the '838 reference proper when the cited reference fails to teach or suggest every element of the claimed invention?

ISSUE 2: Is the Section 103(a) rejection of claims 1-16 over the '838 reference proper when the Examiner failed to provide any evidence of motivation for modifying the '838 reference?

ISSUE 3: Is the Section 112, first paragraph rejection proper when the subject matter upon which the rejection is based is not claimed and, as such, is not subject to the disclosure requirements of Section 112?

ISSUE 4: Is the Section 112, first paragraph rejection proper when the Specification clearly describes example embodiments for the claimed elements of the present invention in a manner that would enable one skilled in the art to make and use the invention?

ISSUE 5: Is the finality of the Section 112, first paragraph rejection proper when the Examiner failed to answer the substance of the Appellant's traversal as required by M.P.E.P.§707.07(f)?

VII. Grouping of Claims

For purposes of this appeal, claims 1 and 9 are in group 1, claims 2 and 4-7 are in group 2, claims 3 and 8 are in group 3, claims 10-15 are in group 4 and claim 16 is in group 5. The claims as now presented do not stand or fall together.

VIII. Argument

Group 1 of the claims is separately patentable over the prior art and over the remaining claim groups of the present invention because it is directed to subject matter that includes a method of detecting defects in a semiconductor device that includes analyzing the device via a comparison of a relational factor of two beams of light from reflected light from the device. Group 2 of the claims is separately patentable over the prior art and over the other claim groups because it is directed to subject matter that includes using a reference die in the comparison for detecting a defect in the die being analyzed, which is not necessarily required in the other claim groups. Group 3 of the claims is separately patentable over the prior art and over the other claim groups because it is directed to subject matter that includes using a relational factor that is a function of a time differential between beams of light for analyzing the die, which is not

necessarily required in the other claim groups. Group 4 of the claims is separately patentable over the prior art and over the other claim groups because it is directed to subject matter that includes a system adapted for detecting defects in a semiconductor device by analyzing the device via a comparison of a relational factor of two beams of reflected light from the device, which is not necessarily required in the other claim groups. Group 5 of the claims is separately patentable over the prior art and over the other claim groups because it is directed to subject matter that includes a system adapted to analyze a die via a relational factor that is a function of a time differential between beams of light, which is not necessarily required in the other claim groups.

ISSUE 1: The Section 103(a) rejection of claims 1-16 over the '838 reference is improper because the cited reference fails to teach or suggest every element of the claimed invention and, therefore, fails to establish a *prima facie* case of obviousness.

The Section 103(a) rejection of claims 1-16 does not cite a reference or combination of references that teaches or suggests every element of the claimed invention. Instead, the Examiner relied on an unsupported assertion of obviousness to allegedly arrive at teaching of the claimed invention. In order to establish a *prima facie* case of obviousness, the prior art must teach every element of the claimed invention (*see* M.P.E.P. §706.02(j)). The Examiner expressly acknowledges that the '838 reference fails to teach or suggest claimed elements of the present invention that include defect detection and/or thinning, as indicated on page 3 of the Office Action mailed on January 30, 2001. In an attempt to modify the '838 reference, the Examiner indicates the following, also on page 3 of the Office Action:

> It would have been obvious to one of ordinary skill in the art at the time the invention was made to [u]se the Marx apparatus when the defects desired to be detected are height defects. With regard to thinning the die beforehand applicant points out that such thinning is well known in the art. See page 3, line 18+ of the specification.

This assertion of obviousness does not provide any factual teaching of all of the claimed subject matter of the present invention. For example, independent claims 1, 10 and 11 are directed to subject matter that includes "comparing a relational factor that is a function of the two beams of light with a reference and detecting therefrom a surface defect in the die." Claim 2 is directed to subject matter that includes using a nondefective semiconductor die to obtain the reference used

in claim 1. Claim 3 is directed to subject matter that includes comparing a relational factor that "is a function of a time differential, or intensity." The Examiner's rejection regarding defect detection, the substance of which is quoted above, makes no mention whatsoever of these claim limitations. Therefore, a *prima facie* case of obviousness has not been established, and the Section 103(a) rejection should be removed.

ISSUE 2: The Section 103(a) rejection of claims 1-16 over the '838 reference in improper because the Examiner failed to provide any evidence of motivation for modifying the '838 reference.

Appellant submits that the Section 103(a) rejection should be removed because the Examiner has not provided motivation for modifying the '838 reference. The Examiner has made broad conclusory statements regarding the use of the '838 reference for detecting defects without providing evidence of motivation of why one skilled in the art would have been motivated to modify the '838 reference to arrive at the presently claimed invention. Specifically, the Examiner has not provided any evidence of teaching or suggestion for using the '838 reference in connection with defect detection in a semiconductor die, as claimed in the present invention. Furthermore, Appellant has reviewed the '838 reference and cannot find teaching or suggestion for modifying the reference to achieve the claimed limitations. Recent case law indicates that evidence of the reasons one of ordinary skill in the art would have been motivated to select the references and combine them should be specifically identified and shown by some objective teaching in the prior art leading to the modification. *See, e.g., In re Dembiczak*, 175 F.3d 994, 50 USPQ2d 1614 (Fed. Cir. 1999). In the present instance, the Office Action has neither indicated reasons why one skilled in the art would be motivated to modify the '838 reference, nor provided any evidence of factual teachings, suggestions or incentives from the prior art that lead to the modification. Therefore, Appellant submits that the Section 103(a) rejection is improper and should be removed.

ISSUE 3: The Section 112, first paragraph rejection is improper because the subject matter upon which the rejection is based is not claimed and, as such, is not subject to the disclosure requirements of Section 112.

The Section 112, first paragraph rejection of claims 1-16 is based upon terms that include unclaimed subject matter. Appellant submits that the rejection is improper because "the

parameters of a section 112 inquiry are set by the claims" and such "[u]nclaimed subject matter is not subject to the disclosure requirements of § 112." *See* Zygo Corp. v. Wyko Corp., 79 F.3d 1563, 1567 (Fed. Cir. 1996) (emphasis in original). In the instant Application, the limitations referred to in the rejection include "how the light [is] reflected from the back of the semiconductor die," "polarization orientations," "light scattering," "confocal interferometer structure" and "information of defects encoded" in reflected light, as indicated on page 2 of the Office Action mailed on January 30, 2001. However, none of these limitations are claimed, nor are they necessary to practice the present invention. In specific regard to the Examiner's question of "how the light [is] reflected from the back of the semiconductor die," the related assertion that, as claimed, "light never reaches any of the defects" is incorrect and confusing. The claims of the present invention are directed to subject matter including directing "a first beam of light *into* the back side of a semiconductor die" and detecting a "surface defect *in* the die" (emphasis added), as discussed in both previous Office Action Responses. Therefore, the light reaches defects at a surface *in* the die, and any disclosure of how light is reflected from the die is directed to reflections from a defect at a surface in the die (see ISSUE 4). Appellant submits that the Section 112 rejection is not based upon claimed limitations and, therefore, the rejection is improper and should be removed (*see id.*).

ISSUE 4: The Section 112, first paragraph rejection is improper because the Specification clearly describes example embodiments for the claimed elements of the present invention in such a manner that enables one skilled in the art to make and use the invention.

Claims 1-16 stand rejected under Section 112, first paragraph, as containing subject matter that was not adequately described in the Specification. However, Appellant submits that the Specification and claims are clearly sufficient to enable one skilled in the art to make and use the invention. Regarding how the light is reflected from the die, Appellant submits that the Examiner is erroneous in assuming that the light must reflect "at the surface of the back side" and, as such, "no light enters the die." Rather, reflections from various defects, surfaces and other portions in the die can make up the reflection. For example, page 8, lines 9-16, page 10, lines 18-23 and FIG. 2, item 232 at surface 231 are all example embodiments directed to light reflected from a portion in the die. In addition, the following paragraph, taken from the

Specification beginning at line 15 of page 11, describes various other example portions of the die from which reflections may be obtained:

> In particular example embodiments, the reflecting surface is the transition in substances from one material to another material (such as from an epitaxial silicon region to an oxide), the reflecting surface is a defect in one material type (such as within a well region), and the reflecting surface is transition from one concentration of doped silicon to another concentration of doped silicon (such as from a p+ epitaxial silicon to an active or well region). In various testing applications of a flip-chip die, reflecting surfaces of these example types are tested to detect defects including but not limited to: contaminants such as potassium deposits, fractures in the silicon, various crystal defects, particulates and dopants. For such defects, the optical path difference profiled in connection with development of the reference can be readily distinguished from the optical path difference profiled in connection with die under evaluation, for example, by examining shifts in intensity.

In this regard, claim 1 is directed to directing light "into the back side" of the die, and the portion of the die into which the light is directed reflects the light.

Furthermore, regarding the Examiner's rejections based upon elements that include polarization orientations, light scattering, light containing encoded information and interferometer structure, Appellant submits that these elements are not specifically claimed nor are they necessary to practice the invention, as discussed in ISSUE 3 above. In specific regard to interferometer structure, Appellant submits that FIG. 2 shows an example structure that can be used in a manner similar to other disclosed interferometry-related techniques. In addition, various interferometer structures would be applicable for use in connection with the present invention, and one skilled in the art would recognize what such interferometer structures are. For example, as the Examiner acknowledges on page 2 of the Office Action mailed on January 30, 2001, the pages in the text of Confocal Scanning Microscopy and Related Imaging Systems teach a confocal interferometer. In regard to light containing encoded defect information, Appellant submits that various examples for detecting a defect using the light are provided in the Specification, including the optical path difference implementation discussed in the paragraph quoted above. In addition, as the present invention is applicable to the detection of various defects from a variety of types of semiconductor dies, the present invention can be used in connection with many different types of reflections and reflected light. Therefore, Appellant submits that the Section 112, first paragraph rejection is improper and should be removed.

ISSUE 5: The finality of the Section 112, first paragraph rejection is improper because the Examiner failed to answer the substance of the Appellant's traversal as required by M.P.E.P.§707.07(f).

The Examiner failed to take note of the Appellant's traversal of the Section 112, first paragraph rejection and answer the substance of it. M.P.E.P. §707.07(f) states, in pertinent part, the following:

> Where the requirements are traversed, or suspension thereof requested, the examiner should take proper reference thereto in his or her action on the amendment. Where the applicant traverses any rejection, the examiner should, if he or she repeats the rejection, take note of the applicant's argument and answer the substance of it. If a rejection of record is to be applied to a new or amended claim, specific identification of that ground of rejection, as by citation of the paragraph in the former Office letter in which the rejection was originally stated, should be given.

In this regard, M.P.E.P. §707.07(f) indicates that the Examiner should take note of the Appellant's argument regarding the impropriety of the Section 112 rejection and answer the substance of it. This is consistent with the purpose of aiding the Appellant in judging the propriety of continuing the prosecution, as indicated in 37 C.F.R. §1.104(a)(2).

In this instance, the Examiner failed to answer Appellant's argument requesting "clarification because none of these [polarization orientations and light scattering] elements are specifically claimed" as presented in response to the Examiner's assertion that these unclaimed elements were not disclosed in the Specification. The Examiner also failed to answer Appellant's argument requesting "clarification because no such 'encoded' defect information is claimed in the present invention" as presented in response to the Examiner's assertion that "the first light beam is reflected at the surface of the back side" and could not include "encoded" information of defects. Regarding the reflected light beam, Appellant submits that the Examiner's assertion that the first light beam is reflected at the surface of the back side (see page 4 of the Office Action mailed on January 30, 2001) is confusing and incorrect. Specifically, the reflection is from a defect *in* the die via a first beam of light directed "*into* the back side of the semiconductor die," as claimed, as indicated in the Specification and as repeated in previous Office Action Responses, rather than necessarily being from a surface *on* the back side. Appellant had requested clarification in the Office Action Responses filed on December 22, 2000 and on March 30, 2001. The Examiner did not answer these traversals and, as a result, the Appellant was not afforded the opportunity to judge the propriety of the §112 rejection and to

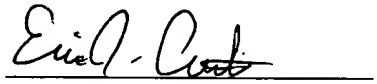
form a response thereto. Therefore, Appellant requests that the finality of the Office Action mailed on January 30, 2001 be removed, that the Examiner take reference to the traversal and that the Appellant have an opportunity to respond thereto, should the rejection be maintained.

IX. Conclusion

Appellant respectfully requests reversal of the rejection as applied to the appealed claims and allowance of the application.

Respectfully submitted,

CRAWFORD PLLC
1270 Northland Drive, Suite 390
Saint Paul, MN 55120
651.686.6633



Name: Eric J. Curtin
Reg. No.: 47,511

APPENDIX OF APPEALED CLAIMS

1. For a semiconductor device that includes a semiconductor die having a circuit side and bulk silicon in an back side opposite the circuit side, a method for detecting a defect at a surface in the die, comprising:

locating a first beam splitter for optical manipulation relative to the back side of the semiconductor die;

directing light of a known wavelength at the beam splitter, wherein the first beam splitter is adapted to direct a first beam of light into the back side of the semiconductor die which reflects a second beam of light back;

redirecting the second beam to a second beam splitter, the second beam splitter generating third and fourth beams of light; and

analyzing the third and fourth beams of light, including comparing a relational factor that is a function of the two beams of light with a reference and detecting therefrom a surface defect in the die.

2. A method, according to claim 1, further including using the first and second beam splitters to generate different third and fourth beams from a nondefective semiconductor and analyzing the different third and fourth beams of light to develop the reference.

3. A method, according to claim 2, wherein the back side of the semiconductor die reflects the second beam of light back to the first beam splitter, and wherein the relational factor is a function of a time differential, or intensity, between the third and fourth beams of light.

4. A method, according to claim 3, further including thinning the back side of the die before the steps of claim 1.

5. A method, according to claim 4, wherein thinning the back side of the die includes locally thinning a portion of the back side of the die.

6. A method, according to claim 4, wherein thinning the back side of the die includes locally thinning a portion of the back side of the die to a thickness of less than about 20 microns.

7. A method, according to claim 1, wherein the light of a known wavelength is near infra-red light.

8. A method, according to claim 1, wherein the relational factor is a function of a time differential, or intensity, between the third and fourth beams of light.

9. A method, according to claim 1, wherein the back side of the die into which the beam of light is directed has a thickness of at least about 20 microns.

10. A system for detecting a defect in a semiconductor device that includes a semiconductor die having a circuit side and bulk silicon in an back side opposite the circuit side, comprising:

first beam splitter means for beam splitting and adapted for optical manipulation relative to the back side of the semiconductor die;

laser means for directing light of a known wavelength at the first beam splitter means, wherein the first beam splitter means is adapted to direct a first beam of light into the back side of the semiconductor die which reflects a second beam of light;

second beam splitter means for generating third and fourth beams of light in response to the second beam being a redirected; and

means for analyzing the third and fourth beams of light, including means for comparing a relational factor that is a function of the two beams of light with a reference and detecting therefrom a surface defect in the die.

11. A system for detecting a defect in a semiconductor device that includes a semiconductor die having a circuit side and bulk silicon in an back side opposite the circuit side, comprising:

a first beam splitter adapted for optical manipulation relative to the back side of the semiconductor die;

a laser for directing light of a known wavelength at the first beam splitter, wherein the first beam splitter means is adapted to direct a first beam of light into the back side of the semiconductor die which reflects a second beam of light back;

a second beam splitter for generating third and fourth beams of light in response to the second beam being a redirected; and

a processor adapted for analyzing the third and fourth beams of light, including comparing a relational factor that is a function of the two beams of light with a reference and detecting therefrom a surface defect in the die.

12. A system, according to claim 11, wherein the back side of the semiconductor die reflects the second beam of light back to the first beam splitter.

13. A system, according to claim 11, wherein the laser is a YAG laser.

14. A system, according to claim 11, further including means for thinning the back side of the die.

15. A system, according to claim 11, wherein the laser is a YAG laser, and further including means for thinning the back side of the die.

16. A system, according to claim 11, wherein the relational factor is a function of a time differential, or intensity, between the third and fourth beams of light.